THURSDAY, DECEMBER 8, 1887.

TECHNICAL EDUCATION IN MANCHESTER.

PROFESSOR HUXLEY could scarcely have anticipated the ready response Manchester has given to the challenge he threw down at the close of his most able address at the Town Hall on the 29th ult. In speaking of one of the great problems of the day, that of meeting ever-increasing competition and yet maintaining the proper social condition of the workers, he said :—"I have ventured to put this before you in a bare and almost cynical fashion because it will justify the strong appeal which I make to all concerned in this work of promoting industrial education to have a care at the same time that the conditions of industrial life remain those in which the physical energies of the population may be maintained at a proper level, in which their moral state may be cared for, in which there may be some days of hope and pleasure in their lives, and in which the sole prospect of a life of labour may not be an old age of penury. . . . I therefore confidently appeal to you to let those impulses have full sway, and not to rest until you have done something better and greater than has yet been done in this country in the direction in which we are now going."

Only a few hours before the utterance of these words the trustees of the late Sir Joseph Whitworth—who during his life-time did so much to encourage and promote the higher education of working engineers—made a munificent offer to the city of Manchester; an offer which was only made public by Mr. Darbishire after Prof. Huxley had finished his address, and which goes some way towards realizing what Prof. Huxley remarks may by some be looked upon as the Utopian dream of a student. The gift consists of a plot of land of about twenty-five acres in one of the best situations in the city, which the trustees have purchased for the sum of £47,000. They propose to offer the whole of this to the Corporation of Manchester upon trust, two-thirds to be maintained as a public park, and one-third as a site for the following institutions: (1) an appropriate Institute of Art, with galleries for paintings, for sculpture and moulded form, and for architectural illustration; (2) a comprehensive Museum of Commercial Materials and Products; (3) a Technical School on a complete scientific and practical scale. The necessary buildings are to be raised by the Corporation and by public-spirited inhabitants of the great district which owns Manchester as its metropolis; and the Whitworth Trustees add that, if this work be heartily undertaken, their own further contributions may be looked for.

Such a result of the movement for the Extension of Technical Education and for the higher culture of our toiling thousands may indeed be welcomed, and the National Association, under whose auspices this meeting was held, may well be congratulated on this outcome of its autumn work. But this is not all, for it is not unlikely that the surplus, amounting, it is believed, to about £50,000, now placed at the disposal of the guarantors of the Jubilee Exhibition, may be applied to furthering this enterprise. Manchester has thus before it the prospect of showing England what can be done to promote educational progress in this direction, and to inaugurate a movement which ought to be followed by all the great cities in the country. Can we doubt that the sons of those whose energy and clear-sightedness have in times past placed Manchester in the van of the most important social movements of the day will prove themselves equal to the task which they have now a splendid opportunity of accomplishing? It is by caring thus for the well-being of our workers that the stable condition of society, referred to by Prof. Huxley, can be best secured; for truer words were never spoken than those in which he stated his belief that, in order to succeed in the competition which is every day becoming more keen, it is not sufficient that our people shall have the knowledge and the skill which are required, but that they must also have the will and energy and the honesty without which neither knowledge nor skill can be of any permanent avail. Mere technical instruction in handicraft or science must, in short, be based on a sound preliminary education. We need to train our workers to be not only clever artisans, but honest men who take pride in the quality no less than in the quantity of their work. It is because these were the views upheld by Sir Joseph Whitworth, and acted upon by him during his lifetime, that his trustees have felt that in no better way could they carry out the important ends for which he laboured than by starting a movement having for its object not merely the technical training of the artisan, but his moral, intellectual, and physical advancement.

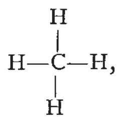
H. E. R.

TRIDIMENSIONAL FORMULÆ IN ORGANIC CHEMISTRY.

Dix Années dans l'Histoire d'une Théorie. Deuxième Édition de "La Chimie dans L'Espace." Par J. H. Van 't Hoff. (Rotterdam: P. M. Bazendijk, 1887.)

THIS interesting monograph gives an account, partly historical, partly expository, of what in our opinion is the most important theoretical contribution towards solving the problem of the constitution of organic compounds that has been made since the idea of a definite union of atoms within the molecule was first introduced into chemistry, of which idea, indeed, the new theory is an expansion. The work has the advantage of being written by one of the originators of the theory.

The linked-atom formulæ, which have so powerfully aided the development of organic chemistry, never professed to give any information as to the relative positions of the atoms in space. All that the "links" or "bonds" denoted was the existence of a closer relation of attraction (of a kind not further specified) between atoms represented as directly linked than between atoms represented as not directly linked. The question of the actual position of these atoms was left entirely open. If, therefore, anyone gathered from the graphic formula of methane,



$$\begin{array}{c}\mathrm{H}\\ |\\ \mathrm{H—C—H,}\\ |\\ \mathrm{H}\end{array}$$

for example, that the five atoms of this compound were necessarily situated in one plane, that person was merely permitting the geometrical properties of paper (or blackboards) to influence his conceptions unduly.

In the great majority of cases the ordinary graphic formulæ fulfilled the purpose for which they were primarily devised: they enabled chemists to predict the number and constitution of the isomerides possible for any given combination of atoms. But there were cases, on the other hand, in which the number of isomerides discovered by experiment exceeded that predicted by the theory. This was especially noticeable in the case of those compounds which in the liquid form or in solution produce rotation of the plane of polarized light. Thus, of three compounds to which chemists, from a study of their modes of formation and decomposition, were obliged to ascribe identical atomic linkage, one would be found to cause rotation of the polarized ray to the right, another to the left, whilst a third was optically inactive. As this optical difference was frequently the only difference discoverable, the phenomenon was described as "physical" isomerism—a name which appeared to suggest that the investigation of it lay outside the province of chemistry. Wislicenus, however, in 1873, in discussing an isomerism of the foregoing type occurring in the case of fermentation-lactic acid and paralactic acid, suggested that this was really a "geometrical" isomerism; that, although the mode of linkage of the atoms was undoubtedly the same in the two compounds, the positions of the atoms in space were different.

The demand thus made for a system of tridimensional formulæ was speedily responded to. In the following year, Van 't Hoff, in Holland, and Le Bel, in France, independently, and almost simultaneously,[1] suggested a very simple hypothesis with regard to the distribution of the four affinities of the atom of carbon. From this hypothesis they developed a system of formulæ under which not only the old anomalies of isomerism disappeared, but new lines of experiment in the preparation of unknown isomerides were indicated.

Van 't Hoff and Le Bel called attention to the hitherto unnoticed fact that all organic compounds which in the liquid state or in solution exhibit optical activity, contain in their constitutional formulæ at least one carbon atom, the four affinities of which are satisfied by four *different* atoms or groups. Such a carbon atom they termed, for reasons to be explained presently, "asymmetric" (Van 't Hoff), or "dissymmetric" (Le Bel).

With regard to the distribution of the affinities of an atom of carbon, Van 't Hoff and Le Bel made the assumption that the four monad atoms or groups satisfying the four affinities of such a tetrad atom are situated at the solid angles of a tetrahedron, the centre of which is occupied by the carbon atom. If, now, the four monad atoms or groups are dissimilar, as in the case of optically active compounds, it is possible to arrange them about the angles of the tetrahedron in two different ways, so as to produce two *asymmetric* tetrahedra (considered with regard to the positions of these atoms or groups)—two non-superposable tetrahedra, one of which is the mirror-image of the other. A continuous curve, passing through the four atoms or groups in the same order, will in the one case describe a right-handed, in the other a left-handed, screw-line. Two compounds thus differing in atomic structure only as regards conditions of symmetry might be expected to possess the same chemical and physical properties, save where dissymmetry or polarity is concerned. As a fact, this is found to be the case with optically active compounds. When a compound contains an asymmetric carbon atom, this compound, provided that it has been adequately investigated, can always be shown to exist in two modifications, possessing the same chemical properties and displaying the same chemical reactions, and, as regards physical properties, agreeing in melting-point, boiling-point, solubility, specific gravity, and all other properties not involving the operation of polar forces. But let dissymmetry or polarity in any form intervene, and the non-identity of the two compounds is at once manifested. Thus, as regards the action of the compounds upon polarized light, the one compound turns the polarized ray through a given angle to the right, the other through the same angle to the left. Again, if the two compounds crystallize, although they do so in forms belonging to the same system and having the same angles, yet the crystals exhibit hemihedral faces which are situated to the right in the one case, and in the other to the left. The one crystal is thus the mirror-image of the other—a relation corresponding with that which is supposed to prevail between the asymmetric carbon atoms themselves within the molecule. These two hemihedral crystals also display opposite pyro-electricity. Even the otherwise identical chemical action of the two compounds may be modified by the dissymmetry of a third compound with which they combine; thus, for example, a dextro-rotatory and a lævo-rotatory acid differ in the degree of their affinity for a dextro-rotatory base, and the two resulting salts are generally quite distinct in their properties.

In all artificial syntheses of compounds containing an asymmetric carbon atom the substance obtained is optically inactive. This was to be expected. The chances in favour of the formation of each of the two modifications of opposite rotatory power are equal: both are therefore formed in equal quantity; and the resulting mixture is inactive. There are three known methods of separating the optically active constituents of such a mixture. These methods, due to M. Pasteur, were discovered, it should be mentioned, many years ago, before the Van 't Hoff-Le Bel hypothesis was put forward. The separation is effected: (1) by the greater ease with which one of the two modifications is attacked by some particular micro-organism, it being thus possible to destroy the whole of one modification leaving the other almost intact, and by properly selecting the organism even to destroy at will either the dextro-rotatory or the lævo-rotatory modification; (2) by the different degree of affinity which the two modifications exhibit towards some other optically active compound; and (3) by means of the fact that under certain conditions of temperature and concentration it is sometimes possible to separate the two modifications by ordinary crystallization. By these means Pasteur succeeded in breaking up racemic acid into dextro-tartaric and lævo-tartaric acids.

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[1] Van 't Hoff's views were first published in a pamphlet in the Dutch language, in September 1874. Le Bel's original memoir appeared in the *Bulletin de la Société Chimique*, in November of the same year. In May 1875, Van 't Hoff published his pamphlet, "La Chimie dans l'Espace," which, however, did not attract much notice until the appearance of the German translation by Herrmann in 1877.

Optical inactivity may also be due to mutual compensation between two asymmetric carbon atoms, of equal and opposite asymmetry, within the molecule itself. This is the case with inactive tartaric acid.

At the present moment there is no case known which contradicts the foregoing hypothesis. A few substances, which, at the time when the hypothesis was first put forward, were believed to be optically active, and yet contained in their molecule no asymmetric carbon atom, have since been shown to owe their supposed optical activity to impurities. On the other hand, the presence of an asymmetric carbon atom in the formula of an apparently inactive compound has been an indication to chemists that the resolution of the compound into two isomerides of opposite optical activity might be profitably attempted; and in the long list of such attempts that have been made within the last few years there appears to be no record of failure.

We have already alluded to M. Pasteur's classical researches on the tartaric acids, in which he not only rendered the Van 't Hoff-Le Bel hypothesis possible by elucidating all the various modes of optical activity and inactivity which it contemplates, but also devised the methods which have so facilitated its experimental development. It only remains to show how near this great investigator came to anticipating the entire hypothesis. In a passage written in 1860, quoted by Prof. Van 't Hoff, M. Pasteur says, referring to the tartaric acids:—

> " Les atomes de l'acide droit sont-ils groupés suivant les spires d'un hélice dextrorsum, ou *placés aux sommets d'un tétraèdre irrégulier*, ou disposés suivant tel ou tel assemblage dissymétrique déterminé ? Nous ne saurions répondre à ces questions. Mais ce qui ne peut être l'objet d'un doute, c'est qu'il y a groupement des atomes suivant un ordre dissymétrique à l'image non-superposable. Ce qui n'est pas moins certain, c'est que les atomes de l'acide gauche réalisent précisément le groupement dissymétrique inverse de celui-ci."

This is divination indeed!

We must content ourselves with merely referring to another portion of the subject—the application of the carbon tetrahedron to the explanation of anomalous cases of isomerism occurring among unsaturated compounds; of which *allo-isomerism*, as Prof. Michael has termed it, fumaric and maleic acids may be taken as illustrations. This application, first made by Van 't Hoff in 1874, and accepted later by Le Bel, has undergone within the past year an extension of extraordinary importance at the hands of Prof. Wislicenus in his elaborate memoir " Ueber die räumliche Anordnung der Atome in organischen Molekulen und ihre Bestimmung in geometrisch-isomeren ungesättigten Verbindungen" (*Abhandl. der Königl. Sächs. Gesellsch.*, 1887), of which a very full and appreciative summary is given by Prof. Van 't Hoff in the present work.

The tridimensional formulæ of organic chemistry are thus an accomplished fact. The treatment of the subject is still, of course, only statical; but, taking care not to lose sight of the limitations thus imposed, the method is a perfectly legitimate one.

F. R. JAPP.

THE MAMMOTH AND THE FLOOD.

The Mammoth and the Flood: an Attempt to Confront the Theory of Uniformity with the Facts of Recent Geology. By Henry H. Howorth, M.P., F.S.A. (London: Sampson Low and Co., 1887.)

MR. HOWORTH'S book is not disproportionate to its subject. But even as the mammoth it had a small beginning. It saw light as letters in NATURE. It cast its swaddling-clothes at the British Association. Grown larger, it took passage on board the *Geological Magazine*, and, as some thought, threatened to swamp that useful but far from bulky periodical. Now, with body and tusks alike full-grown, it comes forth to champion cataclysm and scatter the uniformitarians.

The book consists partly of facts, partly of theories. The one part is separable from the other, though of course sometimes the facts are regarded in the light of the theories. We will endeavour in our notice to keep them apart. The first chapter of the work a little reminds us of the *hors d'œuvre* which sometimes precedes a banquet. Appetizing bits, dainty but miscellaneous—the etymology of mammoth, and its identity with behemoth; griffons and their claws; fossil unicorns; dragons' bones; Indian fabulous beasts; stories of giants, and their bones: with such subjects is the reader's palate stimulated. The next chapter gives a history of opinion on the subject of the remains of the mammoth and the woolly rhinoceros. The author then discusses the abode and range of the mammoth in Asia. He considers it to have been limited to the tundras, which must at that time have enjoyed a climate far more temperate than at the present. Then comes an account of the various discoveries of carcasses, either of the mammoth or of the woolly rhinoceros, in Siberia; followed by the history of the same animals and their associates in Europe. The climate of Europe, when frequented by them, is next discussed, and the facts bearing on the extinction of the mammoth are enumerated, particular stress being laid on the evidence of caves and fissures. Palæolithic man is next called into the witness-box, and cross-questioned as to the cause of his disappearance. That he was exterminated by Neolithic invaders does not, to the author, seem a satisfactory theory. That he was a victim of the Deluge is a simple explanation. The Old World is now quitted for the New—the two Americas are examined. In each, at no distant time, huge mammals flourished; their remains are found under circumstances not materially different from those of similar quadrupeds in the Old World. So they also must have perished in like manner: the Deluge was not limited to Siberia nor to the Old World; it swept alike over tundra and morass, over prairie and pampa; it inundated the New. Of course the West Indies could not escape; apparently no corner of the earth eluded the devastating waves, for Australia, Tasmania, and New Zealand tell the like tale of extinguished life, and sudden devastation. Lastly, there is the citation of historical evidence, in the form of brief summaries of the many variations of the widespread tradition of a universal deluge.

The facts, as indicated by the above statement—which is only a concise summary of the table of contents—cannot wholly be disentangled from the theories, in the light of which they are viewed and in proof of which